A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING

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BY

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Dedicated to my family and teachers

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Dr. Navjot Kaur

ABBREVIATIONS

ABPM	AMBULATORY BLOOD PRESSURE MONITORING
ABP	AMBULATORY BLOOD PRESSURE
BMI	BODY MASS INDEX
BP	BLOOD PRESSURE
CV	CARDIOVASCULAR
DBP	DIASTOLIC BLOOD PRESSUE
ED	EMERGENCY DUTY
HR	HEART RATE
MAP	MEAN ARTERIAL PRESSURE
PP	PULSE PRESSURE
SBP	SYSOLIC BLOOD PRESSURE
SCN	SUPRACHIASMATIC NUCLEUS

ABSTRACT

Background: Ambulatory blood pressure monitoring measures blood pressure at regular intervals in 24 hrs of time period. It is done with the help of portable blood pressure measuring device which is worn for about 24 hrs. Unique data provided by ambulatory blood pressure monitoring includes 24 hr average blood pressure, daytime (awake) blood pressure, night time (asleep) blood pressure, systolic blood pressure load, diastolic blood pressure load, nocturnal dipping of blood pressure.

Aim of Study: A study of effect of shift duty on diurnal variations in blood pressure with ambulatory blood pressure monitoring.

Materials & Methods: This study will be a prospective study and will be conducted on shift duty workers. A Total of 30 candidates will be taken in this study after the informed consent. There will be two sessions of ambulatory blood pressure monitoring. First will be conducted after 4^{th} day of the day shift duty and second will be conducted after 4^{th} day of the night shift duty in same individual. The time period between these two sessions will not be more than 2 months. Blood pressure monitoring will be done after every 20 minutes in day time and 60 minutes at night time.

Results: The mean SBP was significantly higher while sleep hours in night duty as compared to day duty. DBP and MAP were also slightly higher but statistically insignificant. There was statistically insignificant rise in mean SBP, DBP and MAP during awake period of night duty as compared to awake period of day duty. Normal dippers and extreme dippers were found to be more in day duty as compared to night duty. Non dippers were more in night duty as compared to day duty. But reverse dippers were only found in night duty candidates.

Conclusion: Our study concludes that working in shifts alters the normal diurnal rhythm of BP.

Keywords: Ambulatory blood pressure monitoring, shift duty workers and nocturnal dippers.

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INTRODUCTION

Blood pressure is the pressure of circulating blood against the walls of blood vessels. Most of this pressure results from the heart pumping blood through the circulatory system. It is affected by many modifiable and non modifiable risk factors such as age, sex, body build, genetic factors, physical activity, sleep, emotional stress, smoking, alcohol intake as well as dietary habits.

Under 2017 guidelines, all blood pressure measurements over 120/80 mm Hg are considered elevated. Now blood pressure measurements are categorized as Normal systolic blood pressure as less than 120 mm Hg and diastolic less than 80 mm Hg. Prehypertension is defined systolic blood pressure (SBP) between 120-129 mm Hg and diastolic blood pressure (DBP) less than 80 mm Hg. Similarly Stage 1 hypertension is defined as systolic blood pressure between 130-139 mm Hg or diastolic between 80-89 mm Hg. Stage 2 hypertension is defined as systolic blood pressure at least 140 mm Hg or diastolic at least 90 mm Hg.

Blood pressure varies according to many internal and external factors.[1] Diurnal fluctuation in blood pressure is a well known phenomenon. Average nocturnal blood pressure is approximately 15 mm of Hg lower than day time. These fluctuations are due to at least three groups of factors. First, blood pressure and heart rate are regulated by complex internal physiologic mechanisms. Second, it is well known that external stresses and the subject's activities have direct effects on blood pressure and heart rate. Third, daytime and nighttime may attempt to synchronize blood pressure to their own circadian rhythm.[2] This phenomenon can’t be seen in office blood pressure and home blood pressure monitoring. Based on the rate of decline in mean nighttime systolic BP as compared to mean daytime SBP, there are four types of nocturnal dippers:- reverse dippers (<0% fall in nocturnal SBP), non dippers (10%), normal dippers (10-20%), and extreme dippers (20%). Acute sleep deprivation is associated with

an increased sympathetic activity and decreased parasympathetic modulation.[3,4]Sleep disturbance result in sympatho-vagal imbalance.[4,5] Circadian rhythms in body temperature, sleep-wake cycles, metabolism, and blood pressure (BP) are just a few examples. These circadian rhythms are controlled by the central clock in the suprachiasmatic nucleus (SCN) of the hypothalamus and peripheral clocks located throughout the body. Light and food cues entrain these clocks to the time of day and this synchronicity contributes to the regulation of a variety of physiological processes with effects on overall health. The kidney, brain, nervous system, vasculature, and heart have been identified through the use of mouse models and clinical trials as peripheral clock regulators of BP.[6]

Ambulatory blood pressure monitoring is far superior to office based blood pressure monitoring in predicting 24 hour average blood pressure, day blood pressure (awake), night time (asleep) blood pressure, systolic blood pressure load, diastolic blood pressure load, nocturnal dipping of blood pressure. Ambulatory blood pressure is also a better representative of actual blood pressure as office blood pressure is affected by multiple factors including observer error and patient related factors. Ambulatory blood pressure is also useful in studying abnormality of the diurnal rhythm, the short term variability, masked hypertension, white coat hypertension and pseudo resistant hypertension.

The most important physiological mechanism regarding the night shift work is the problem of entrainment (resynchronization) of physiological functions after a phase shift of working and sleeping time and has been reported that the resynchronization of circadian rhythm in blood pressure to a night shift schedule occurs much more rapidly than other circadian parameters such as body temperature. This implies that blood pressure circadian rhythm in sleep-wakefulness. The Circadian blood pressure pattern is changed from a dipper to a non dipper

pattern on the first day of the night shift and reverses to a dipper pattern within a few days.

Majority of circadian rhythm in our body have both an endogenous component regulated by suprachiasmatic nuclei and an exogenous component composed of light dark cycle. 24 hour blood pressure monitoring detects dippers, non dippers, reverse dippers and extreme dippers. It can also measure systolic, diastolic blood pressure load and assess blood pressure variability over the 24 hrs period. It is therefore important to study the effect of shift duty on circadian rhythm which is done with ambulatory blood pressure monitoring.

AIMS AND OBJECTIVES

A study of effect of shift duty on diurnal variations in blood pressure with ambulatory blood pressure monitoring.

REVIEW OF LITERATURE

24 hour blood pressure profiling with the use of ambulatory blood pressure monitoring (ABPM) was first introduced 40 yrs ago.[7] abpm shows bp behavior over a 24-hours period rather than giving a snapshot of bp measured with an inaccurate technique under artificial circumstances.

FACTORS AFFECTING BLOOD PRESSURE

1. **AGE:**

   Both SBP and DBP increases with age, SBP increases more than DBP due decreased distensibility of arteries as their walls become increasingly more rigid following arteriosclerosis with advancing age, however, DBP decreases after 50-60 years of age.

2. **SEX:**

   After puberty, female usually have lower blood pressure than male of the same age, this differences are thought to be due to hormonal variation (may be due to estrogen which prevents atherosclerosis). After menopause women generally have high blood pressure than before.

3. **BODY BUILT:**

   In obese individuals, brachial arterial pressure gives high readings, because there is more tissue between the cuff and the artery. Some of the cuff pressure is dissipated, therefore, pressure obtained using standard arm cuff are falsely high.

4. **TEMPERATURE:**

   Because of increase metabolic rate fever can increase blood pressure, however external heat causes vasodilatation and decrease both systolic and diastolic blood pressure. Cold causes vasoconstriction and elevated both systolic and diastolic blood pressure.

5. **DIURNAL VARIATIONS:**

   Pressure is usually lowest in the morning when metabolic rate is lowest, then rises throughout the day and peaks in the late afternoon or early evening. Reverse rhythm observed in night workers.

6. **EXERCISE:**

   Physical activity increase the cardiac output (due to sympathetic vasoconstriction) and hence the blood pressure. BP comes back to normal within 5 min after stoppage of exercise due to sudden relaxation of muscles which produce vasodilatation.

7. **STRESS:**

   Stimulation of the sympathetic nervous system increase cardiac output and vasoconstriction of the arterioles thus increasing the blood pressure reading. However, severe pain can increase blood pressure.

8. **MEALS:**

   SBP increases by 5-6 mmHg upto 1 hour after meals. DBP remains same or slightly decreases due to vasodilatation in digestive system.

9. **SLEEP:**

   SBP falls in early hours of sleep by 15-30 mmHg, because of general dilatation of vessels in complete relaxed state. However, disturbed sleep increases SBP due to increased sympathetic discharge secondary to skeletal muscle tensioning.

10. **POSTURE**:

    Sudden standing increases DBP, if recorded within 30-60 sec of change in posture after that it comes back to normal via the operation of baroreceptor reflexes.

11. **RACE:**

    African American older than 35 years old tend to higher blood pressure than European of the same age although the exact reasons for this difference are unclear.

24 HOUR BLOOD PRESSURE PROFILE

24 hour ambulatory blood pressure monitoring offers the ability to monitor subjects throughout their daily routines and is useful in identifying patterns of dynamic blood pressure changes during different activities.[3,7] It is useful for predicting the development of hypertension and cardiovascular disease. This method has been used often to assess 24 hour blood pressure profiles in the shift work population, most notably night shift workers.[3,8] Increased systolic and diastolic pressures, as well as heart rate, have been reportedly linked to nightshift workers. Variation of blood pressure throughout the day can be monitored only by ambulatory blood pressure monitoring.[9] Night shift workers are reported to have a greater blood pressure during a work day when compared to a non working day.[10]

Blood pressure increases as small as 5 mmHg for systolic and diastolic blood pressure can be clinically relevant, especially if re-occurring over extended periods of time by increasing the risk of adverse cardiovascular events.

24 HOUR AMBULATORY BLOOD PRESSURE MONITORING

Physicians are more frequently prescribing a blood pressure monitoring device, and the two options are self blood monitoring or 24 hour ambulatory blood pressure monitoring. The 24 hour ambulatory blood pressure monitoring option is preferred due to its reliability and ability to record nocturnal blood pressure monitoring unlike self blood pressure monitoring.[11] The physician can set the monitor to take readings multiple times per hour.

WINDOWS OF THE 24-HOUR CIRCADIAN PROFILE

In clinical practice, mean daytime and nighttime BP readings are generally taken as being the most valuable parameters of abpm,[11-14] but ongoing research indicates that there is much more information to be gleaned from the 24-hour BP cycle. First, the 24-hour period can be divided into a number of windows (Figure 1).

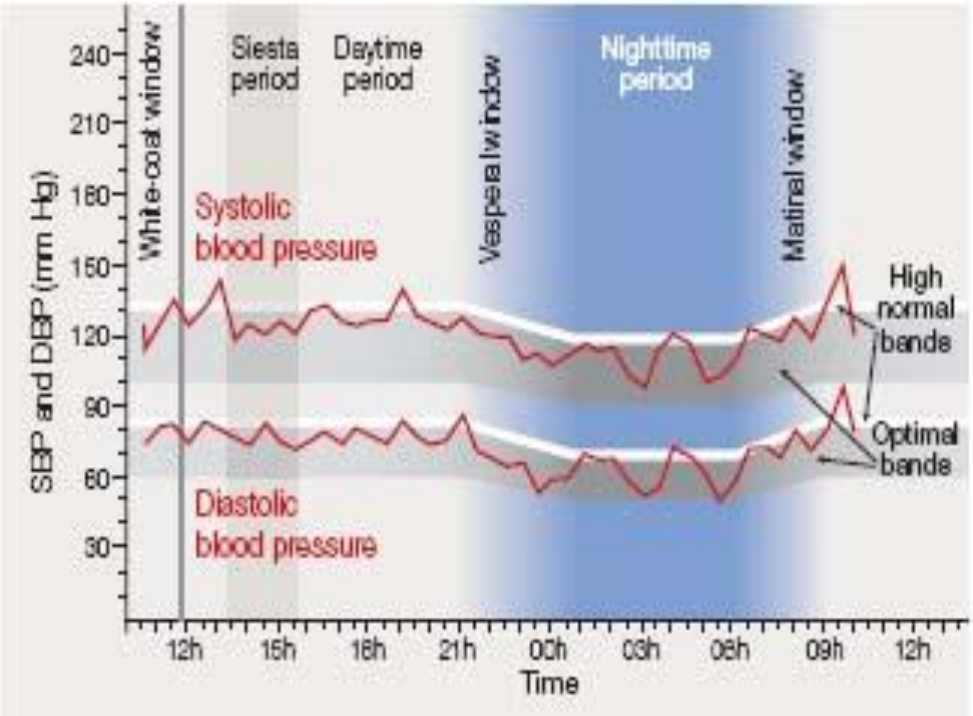

Figure 1. Scheme of ambulatory blood pressure.

WHITE-COAT WINDOW

The white-coat window is the period that extends from the beginning of ABPM recording and lasts for 1 hour.[12,14] During the white-coat window, BP may be influenced by the medical environment. The most popular definition of white-coat hypertension is that BP measured by conventional techniques in the office, clinic, or surgery exceeds 140 mm hg systolic or 90 mm hg diastolic, but when ABPM is performed the average BP is <135 mm hg systolic and 85 mm hg diastolic during the daytime period.[15] It has been shown that the white coat window on ABPM recordings cannot only diagnose the white-coat phenomenon, but also allows identification of a white-coat hypertensive subgroup

with significantly higher pressures.[16] ABPM remains the method of choice for diagnosing white-coat hypertension.[16-18]

DAYTIME WINDOW

The daytime window follows the white-coat window and is the period when the subject is away from the medical environment and engaged in usual activities.[16] For almost all subjects with hypertension, BP readings during this window are lower than conventionally recorded pressures in the office, clinic, or surgery setting.[17] However, bp readings during this period are subject to stress, activity, arm movement, and the effect of exercise and other activities.

VESPERAL WINDOW

In the normal individual, there is a decline in BP in the vesperal window from daytime levels of BP that reaches a plateau during the nighttime period. This period (9.01 pm to 0.59 am on the basis of ABPM commencing at 9 am) is not included in the estimation of day and night mean pressures because this period represents a time during which bed rest is inconsistent and therefore, cannot be categorized reliably.[19] The decline in BP during the vesperal window may be absent (non dipping) so that BP readings do not reach basal levels.[20-22] BP may even rise in the vesperal window to reach levels that are higher than daytime levels (reverse dipping)[23] alternatively, there may be a marked fall in BP during the vesperal window to give the phenomenon of extreme dipping[24] therefore, what happens to BP in the vesperal window predicates the BP level in the basal window.

BASAL WINDOW

The nighttime window follows the vesperal window and is the period between 1.00 am and 6.00 am.[16] BP readings in this window are most likely to coincide with sleep (or if not with actual sleep, with the greatest cessation of activity) and are likely, therefore, to represent a steady state.[25]

MATINAL WINDOW

The matinal window extends from the end of the basal window to the commencement of daytime activities following rising. This period (6.01 am to 8.59 am) is not included in the estimation of day and night mean pressures because this period represents a time during which bed rest is inconsistent and, therefore, cannot be categorized reliably. However, the magnitude of the rise in BP in the matinal window may yield the most valuable prognostic information. In normal subjects, a modest rise in BP occurs in the matinal window preceding awakening from sleep to merely restore the previous daytime level of BP.[25,26]

DIPPING AND NONDIPPING

The Physiological decrease in nocturnal bp relative to day time bp is referred to as nocturnal bp dipping. Arbitrarily, a decrease of 10-20% in nocturnal bp relative to day time bp is considered normal. Nocturnal bp dipping rate = 100 x (day time – night time SBP)/ day time SBP. Those with nocturnal SBP decline <10% are considered non dippers. The “dipper/non dipper” classification was first introduced in 1988 when a retrospective analysis suggested that non dipping hypertensive patients had a higher risk of stroke than the majority of patients with a dipping pattern.[22] It is generally accepted that a diminished nocturnal BP fall is associated with a poor prognosis.[18,19] For example, blunted nighttime dipping of BP is independently associated with angiographic coronary artery stenosis in men.[27] In elderly people with long-standing hypertension, a blunted nocturnal dip in BP is independently associated with lower cognitive performance.[28] Among elderly patients with recently diagnosed isolated systolic hypertension, those with a non dipping nocturnal pattern have been shown to have significantly higher left ventricular masses on echocardiography than dippers.[29] A non dipping nocturnal pattern is also associated with renal and cardiac target organ involvement.[30] Moreover, nocturnal BP is now known to be an independent risk factor for cardiovascular (CV) outcome over and above all other measures of BP.[20,31] For example, in the dublin

outcome study for each 10-mm hg increase in mean nighttime SBP, the mortality risk increased by 21%.[20,25]

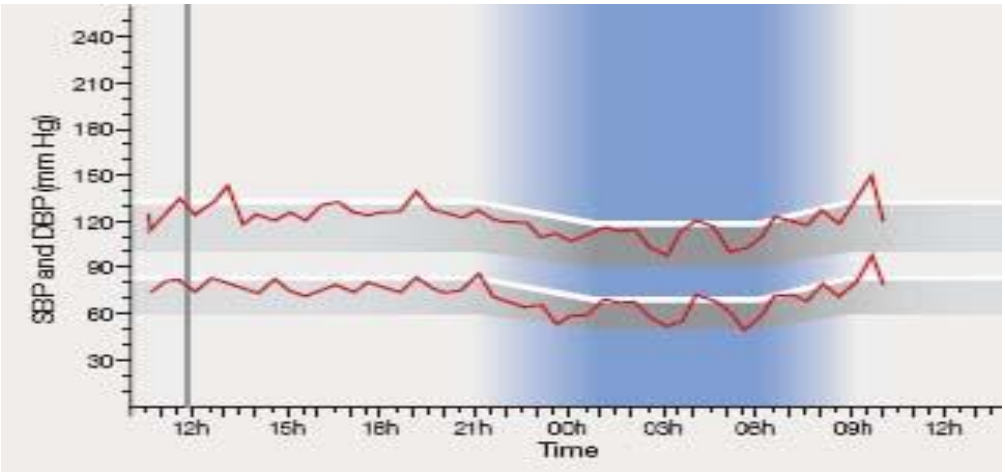

Figure 2. Abpm suggests optimal 24-hour blood pressure (128/78mmHg daytime, 110/62mmHg nighttime). Normal dipping pattern.

REVERSE DIPPING

Reverse dipping characterized by higher night time bp as compared to day time bp. In some patients, BP rises above daytime pressures rather than falling during the night. These patients (also referred to as risers, or extreme non dippers) have the worst CV prognosis, both for stroke and cardiac events.[25]

EXTREME DIPPING

Patients with a marked nocturnal fall in BP, known as extreme dippers, are at risk for nonfatal ischemic stroke and silent myocardial ischemia.[25]

SIESTA DIPPING

A siesta dip in BP on ABPM is common in societies in which an afternoon siesta is an established practice, but in many elderly patients regardless of cultural practice a siesta is often part of the daily routine. There is evidence that ignoring the dipping pattern associated with a siesta distorts the day/night ratio of ABPM and the magnitude of the siesta dip may have prognostic implications.[25, 32]

THE MORNING SURGE

CV events, such as myocardial infarction, ischemia, and stroke, are more frequent in the morning hours soon after waking than at other times of day.[33] Circadian variations in biochemical and physiological parameters help to explain the link between acute CV events and the early morning BP surge.[33,34] The occurrence of stroke and heart attack is more common during this period than at any other time of the day.[34] In older hypertensive subjects, a morning surge in BP—defined as a rise in BP>55 mm Hg from the lowest nighttime reading—carries a risk of stroke almost three times greater than that seen in patients without a morning surge.[25,35]

HYPERTENSION

Hypertension is one of the most common types of cardiovascular disease.[36] hypertension is defined as blood pressure levels that are high enough to cause damage to the heart, blood vessels, and other organs. There are two forms of hypertension, primary hypertension and secondary hypertension. Primary hypertension is more common; about 95% of all diagnosed cases. It is thought that primary hypertension is the combination of multiple blood pressure regulation problems and environmental stressors, which makes it more difficult to treat. Secondary hypertension develops after another medical problem has arisen in the body, thus an effective treatment is more likely. Physiologically, blood pressure falls by >10% during nighttime (asleep). When blood pressure fall by <10% during nighttime, it is defined as non dipping. It is associated with increased risk of stroke, end organ damage, and cardiovascular events including death.[37] several studies showed an association between morning blood pressure surge was associated with decreased mortality in non dipping hypertension patients.[38]

SHIFT WORK

Shift work is identified as work hours that extend beyond the normal 8-hour work day of 8a.m. To 5 p.m. It is common for these shifts to be 12

hours or longer, and they are often worked in succession to one another.[39-41] There are shift work and fixed day and night shift work.[42] nearly all body functions are rhythmic and cyclic; working extended periods of night shift work or rotating shift work can alter the body's normal patterns.[43-45] These alterations can impact weight, physical activity, social interaction and sleep. The human sleep-wake cycle functions under the command of two systems: 1) the circadian system which promotes wakefulness and 2) the homeostatic system which promotes sleep.[44-46] When these internal regulatory mechanisms get out of synchronization, the body cannot maintain its normal sleep/wake cycles. Due to the nature of shift work, the altering of these bodily functions, individuals participating in shift work are at risk for health problems such as sleep disorders, cardiovascular disease, digestive problems and psychological disorders. The demands of shift work include elevated mental stress and altered regulatory functions, all of which have the potential to increase blood pressure and ultimately increasing the risk of cardiovascular disease. It has also been reported that long term exposure to increased blood pressure, secondary to sleep deprivation, can cause the cardiovascular system to reset its normal blood pressure levels to that of a higher blood pressure, causing body to operate on an elevated blood pressure level on a regular basis.[47] A study shows that day shift workers show typical circadian rhythms with a drop in both systolic and diastolic blood pressure at night. This pattern was reversed in night-shift workers.[48] a change in the working time profoundly perturbed the 24 hour blood pressure profile.[49]

SLEEP DURATION IN SHIFT WORKERS

Depriving healthy subjects of sleep has been shown to acutely increase blood pressure and sympathetic nervous system activity. Prolonged short sleep durations could lead to hypertension through extended exposure to raised 24 hour blood pressure and heart rate, elevated sympathetic nervous system activity, and increased salt retention.[49] Sleep restriction and deprivation has been linked to an

increased incidence hypertension in both the normotensive population and already hypertensive population.[50] Usual sleep duration above and below the median of 7 to less than 8 hours per night is associated with an increased prevalence of hypertension, particularly at the extreme of less than 6 hours per night.[51] The rhythm of the human body is characterized with an alternating sleep wake cycle. Among healthy subjects, sleep tends to occur during a particular phase of circadian cycle. Those who work in night shift may attempt to sleep when their body clock is adjusted for the awakening phase. This attempt disturbs the body clock resulting in a contradictory relationship between sleep time and circadian regulation which has adverse effect on family and social life. The average sleep cycle for night shift workers is sleep during the day. Which may be 2-4 hours shorter than that of the day worker sleeping at night. Day sleep is light, fragmented and more likely to be distrupted and hence the insomnia can be severe in night shift workers. It is possible that circadian sleep propensity rhythm and hormonal rhythm are under influence of circadian pacemaker as well as sleep habit.

AWAKE AND SLEEP CYCLE

Diurnal variation in BP is well recognized. Usually, BP rapidly rises on wakening in the early morning, reaches a plateau during the morning, falls slightly in the early afternoon and rises again in the early evening.[51,52] BP decreases gradually in the late evening, drops sharply after falling asleep and is lowest during sleep. These changes in BP are largely attributed to mental and physical activities, and the sympathetic nervous system has a crucial role in the generation of diurnal BP variation.[53-56] It has been shown that diurnal changes in BP coincide with changes in heart rate and the levels of plasma and urinary catecholamine.[54-57] It also has been shown that BP is high during nighttime working hours and low during daytime sleeping hours in shift workers, although the dip in BP during sleeping hours may be attenuated at the beginning of the night shift. [49,58]

The morning rise in BP mainly depends on physical activity after waking. It has been shown that BP changes little after waking when the subjects remain supine, but rises rapidly when they get out of bed.[59] It is also reported that the magnitude of the morning rise in BP is correlated with changes in physical activity.[60] Although the morning rise in BP is a physiological phenomenon, some hypertensive patients show an exaggerated rise in BP that is called the morning surge. Cardiovascular events such as myocardial infarction and stroke occur most frequently in the early morning, and the morning surge in BP appears to have an important role in the onset of these cardiovascular events.[35,61-63] On the other hand, the nighttime dip in BP is also altered in many hypertensive patients.

MATERIALS AND METHODS

This study was a prospective study and was conducted on shift duty workers. A Total of 30 candidates were taken in this study after the informed consent. There were two sessions of ambulatory blood pressure monitoring. First was conducted after 4th day of the day shift duty and second was conducted after 4th day of the night shift duty in same individual. The time period between these two sessions was not more than 2 months. Blood pressure monitoring was done after every 20 minutes in day time and 60 minutes at night time.

Source of Data

Shift duty workers working at nights/ on rotational duty/ alternating shifts.

METHOD OF COLLECTION OF DATA

Patient's history, clinical examination and all investigations was noted down as per detailed performa.

INCLUSION CRITERIA

- Age >30 years.
- Participants interested in study.
- Working at nights/ on rotational duty/ alternating shifts

EXCLUSION CRITERIA

- Age <30 years.
- Those who are not interested in participation

OUTCOME

To observe whether there is any effect of shift duty on diurnal blood pressure or not.

STATISTICAL ANALYSIS

Data was described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the groups were done using Paired t-test for parametric data.

A probability value (*p* value) less than 0.05 is considered statistically significant. All statistical calculations were done using SPSS (Statistical Package for the Social Science) SPSS 17 version statistical program for Microsoft Windows.

OBSERVATIONS AND RESULTS

This was a prospective study conducted on shift duty workers. A total of 30 candidates were taken in this study after the informed consent. There was two sessions of ambulatory blood pressure monitoring. First was conducted after 4th day of the day shift duty and second was conducted after 4th day of the night shift duty in same individual.

TABLE 1: DISTRIBUTION OF SUBJECTS ACCORDING TO AGE GROUP

Age group	No. of cases	Percentage
< 40	15	50.0%
41-50	11	36.7%
> 50	4	13.3%
Total	30	100.0%

Among 30 candidates 50% were less than 40 years old age, 36% were within range of 41- 50 years age and 13.3% were more than 50 years of age.

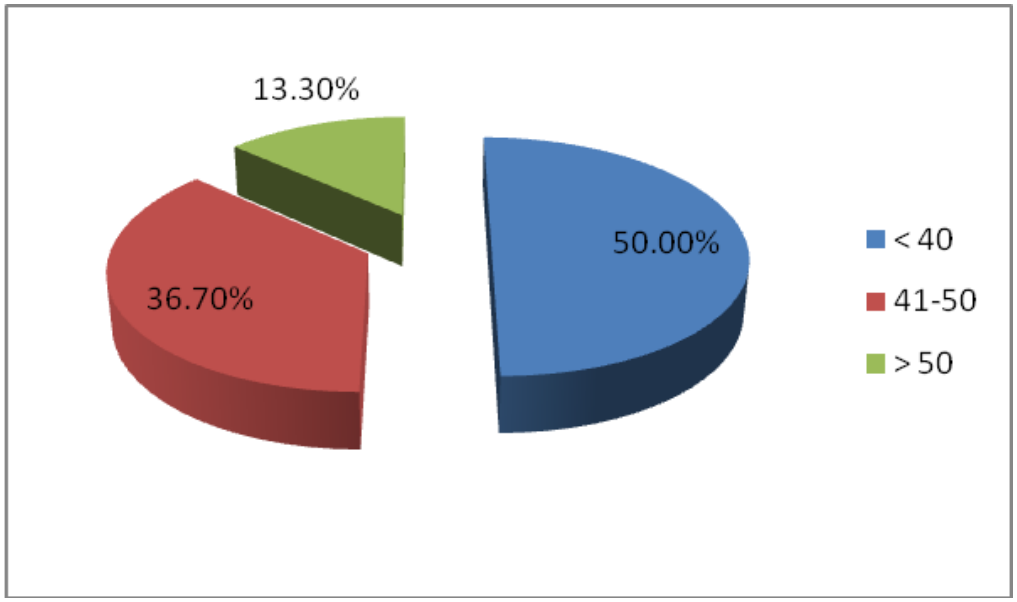

FIGURE 3: DISTRIBUTION OF SUBJECTS ACCORDING TO AGE GROUP

TABLE 2: DISTRIBUTION OF SUBJECTS ACCORDING TO GENDER

GENDER	No. of cases	Percentage
FEMALE	24	80.0%
MALE	6	20.0%
Total	30	100.0%

Among the 30 candidates 24 were females and 6 were males. We observed a female preponderance with female to male ratio of 4:1.

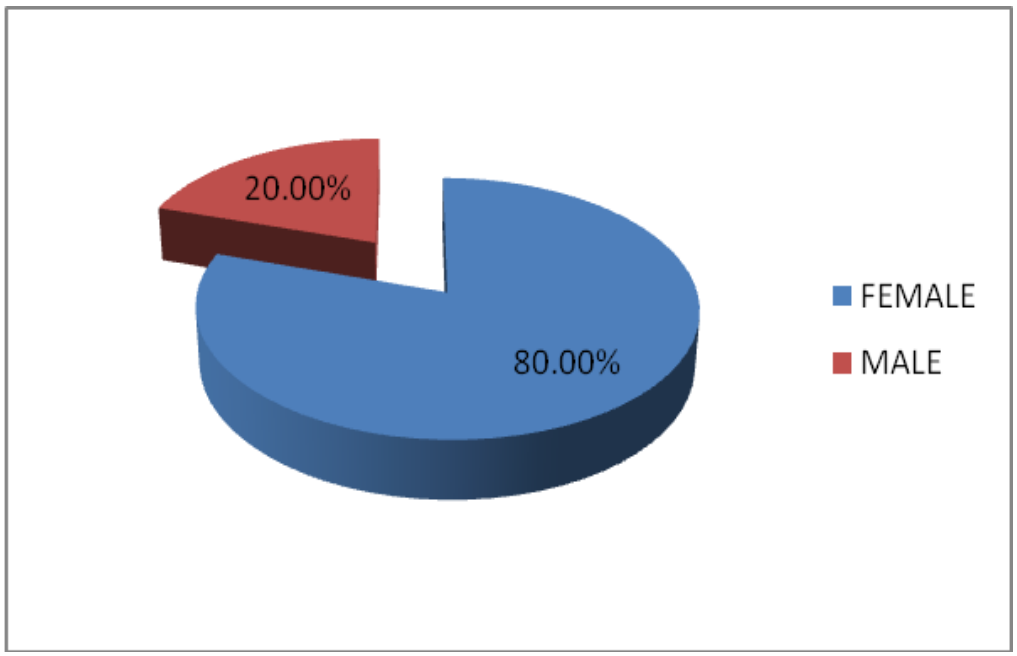

FIGURE 4: DISTRIBUTION OF SUBJECTS ACCORDING TO GENDER

TABLE 3: DISTRIBUTION ACCORDING TO BMI

BMI	No. of cases	Percentage
Underweight	0	0.00%
Normal	19	63.33%
Overweight	10	33.33%
Obese	1	3.33%
Total	30	100.00%

Among 30 candidates 19 (63.33%) were having normal BMI, 10 (33.33%) were overweight and 1 (3.33%) was obese.

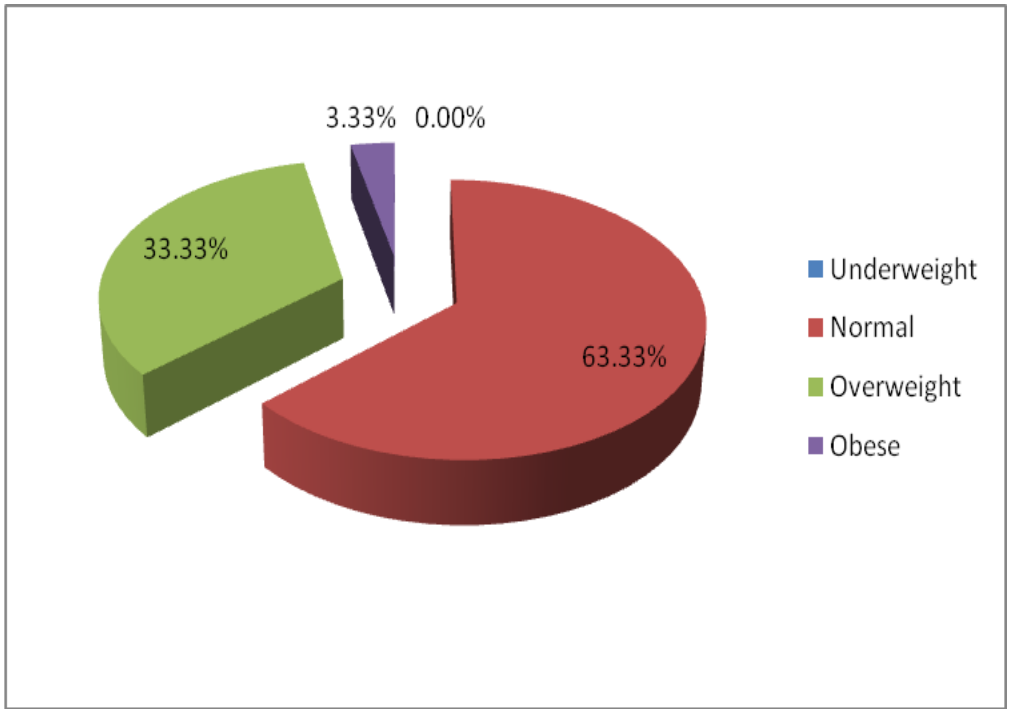

FIGURE 5: DISTRIBUTION ACCORDING TO BMI

TABLE 4: DISTRIBUTION OF CANDIDATES ACCORDING TO OCCUPATION

OCCUPATION	No. of cases	Percentage
LAB TECHNICIAN	1	3.3%
SECURITY GUARD	3	10.0%
STAFF NURSE	17	56.7%
SWEEPER	5	16.7%
WARD ATTANDANT	4	13.3%
Total	30	100.0%

Among 30 candidates 17 were staff nurse, 5 were sweepers, 4 were ward attendants, 3 were security guards and was lab technician.

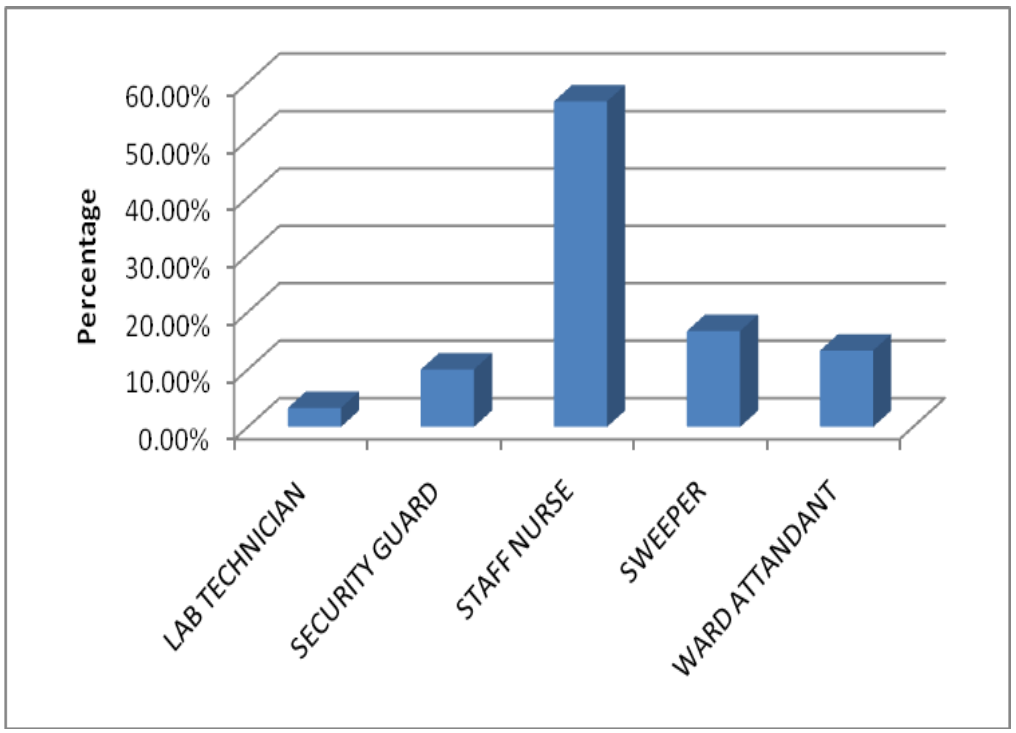

FIGURE 6: DISTRIBUTION OF CANDIDATES ACCORDING TO OCCUPATION

TABLE 5: COMPARISON OF AWAKE ABPM READING IN DAY AND NIGHT DUTY

Awake	Day Duty(day time)		Night Duty(night time)		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
SBP	111.01	10.19	111.24	10.28	-0.159	0.875	-0.23	8.04	-3.23	2.77
DBP	74.07	7.68	76.34	8.29	-1.355	0.186	-2.28	9.21	-5.72	1.16
MAP	86.38	7.81	87.98	8.67	-1.059	0.299	-1.60	8.26	-4.68	1.49

Ambulatory blood pressure readings were recorded during day and night shifts while candidate was on duty and awake. The mean SBP in day shift was 111.01±10.19 which was almost similar to night shift 111.24±10.28 with insignificant p-value (>0.05). The mean DBP in day shift was 74.07±7.68 which was slightly higher than night shift 76.34±8.29 with insignificant p-value >0.05). The mean MAP in day shift was 86.38 ± 7.81which was almost similar to night shift 87.98±8.67 with insignificant p-value (>0.05).

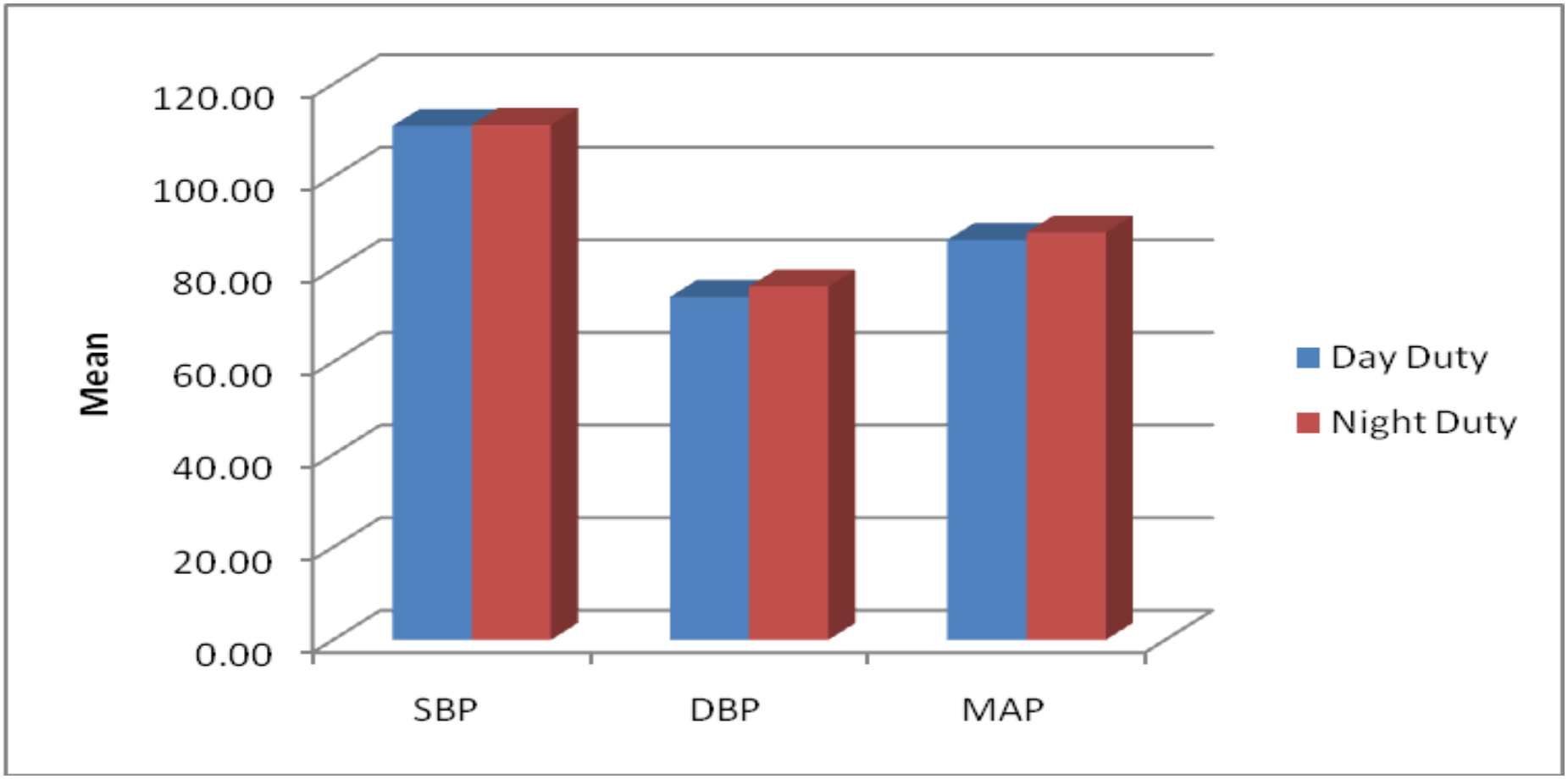

FIGURE 7: COMPARISON OF AWAKE ABPM READING IN DAY AND NIGHT DUTY

TABLE 6: COMPARISON OF SLEEP ABPM READING IN DAY AND NIGHT DUTY

Sleep	Day Duty(night time)		Night Duty(day time)		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
SBP	96.24	9.00	99.10	9.98	-2.310	0.028	-2.87	6.80	-5.40	-0.33
DBP	61.71	7.21	63.17	8.15	-1.330	0.194	-1.46	6.01	-3.71	0.78
MAP	73.22	7.18	75.15	8.29	-1.826	0.078	-1.93	5.79	-4.09	0.23

Ambulatory blood pressure readings were recorded during day and night shifts while candidate was off duty and sleeping. The mean SBP in day shift was 96.24±9.00 which was lower than night shift 99.10±9.98 with significant p-value (<0.05). The mean DBP in day shift was 61.71±7.21 which was slightly lower than night shift 63.17±8.15 with insignificant p-value (>0.05). The mean MAP in day shift was 73.22±7.18 which was slightly lower than night shift 75.15±8.29 with insignificant p-value (>0.05).

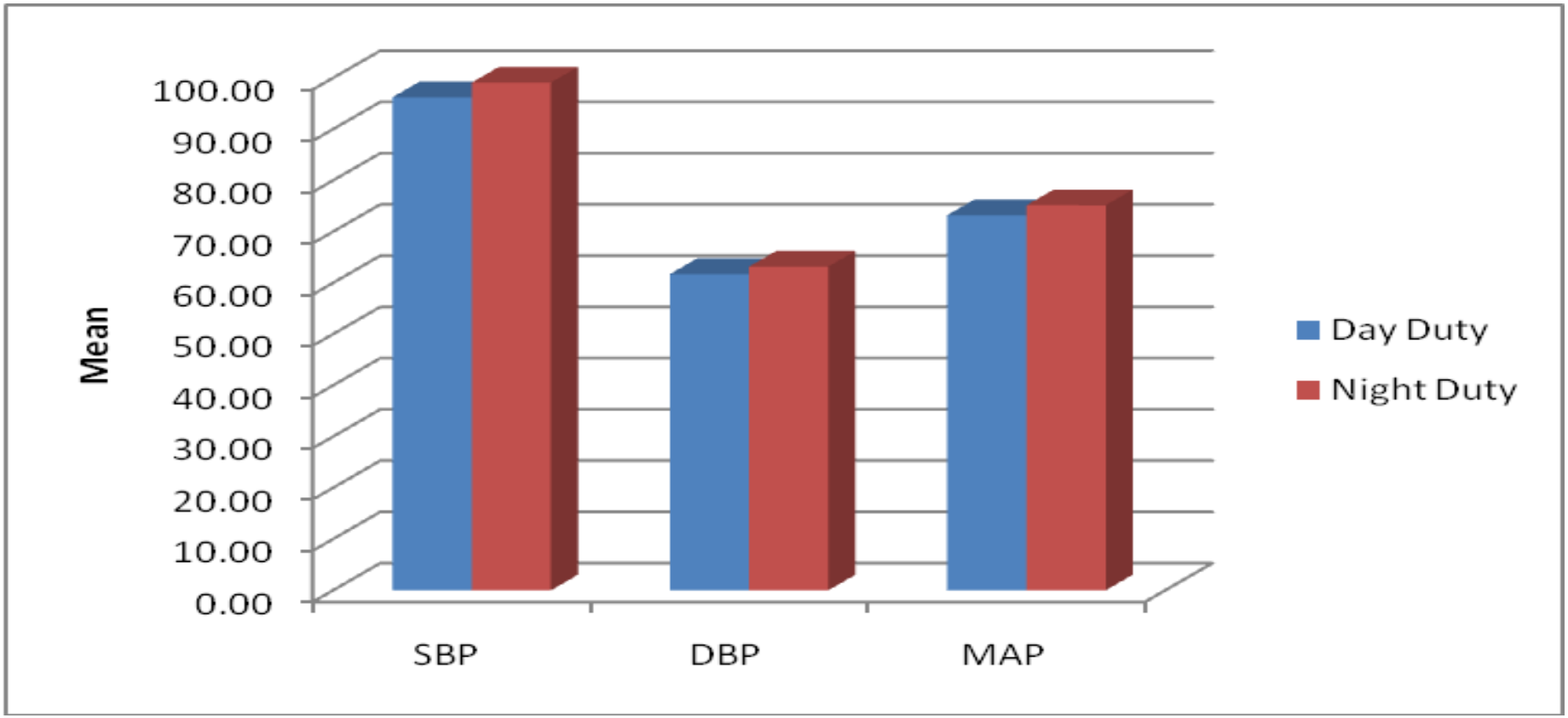

FIGURE 8: COMPARISON OF AWAKE ABPM READING IN DAY AND NIGHT DUTY

TABLE 6: COMPARISON OF AWAKE AND SLEEP ABPM READING IN NIGHT DUTY

Night Duty	Sleep(day time)		Awake(night time)		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
SBP	99.10	9.98	111.24	10.28	-8.056	0.000	-12.14	8.25	-15.22	-9.06
DBP	63.17	8.15	76.34	8.29	-9.126	0.000	-13.17	7.90	-16.12	-10.22
MAP	75.15	8.29	87.98	8.67	-9.488	0.000	-12.83	7.41	-15.59	-10.06

The mean SBP in night shift while sleeping hours was 99.10±9.98 which was lower than awake hours 111.24±10.28 with significant p-value (<0.05). The mean DBP in night shift while sleeping was 63.17±8.15 which was lower than awake hrs 76.34±8.29 with significant p-value (<0.05). The mean MAP in night shift while sleeping was 75.15±8.29 which was lower than awake hrs 87.98±8.67 (p-value <0.05).

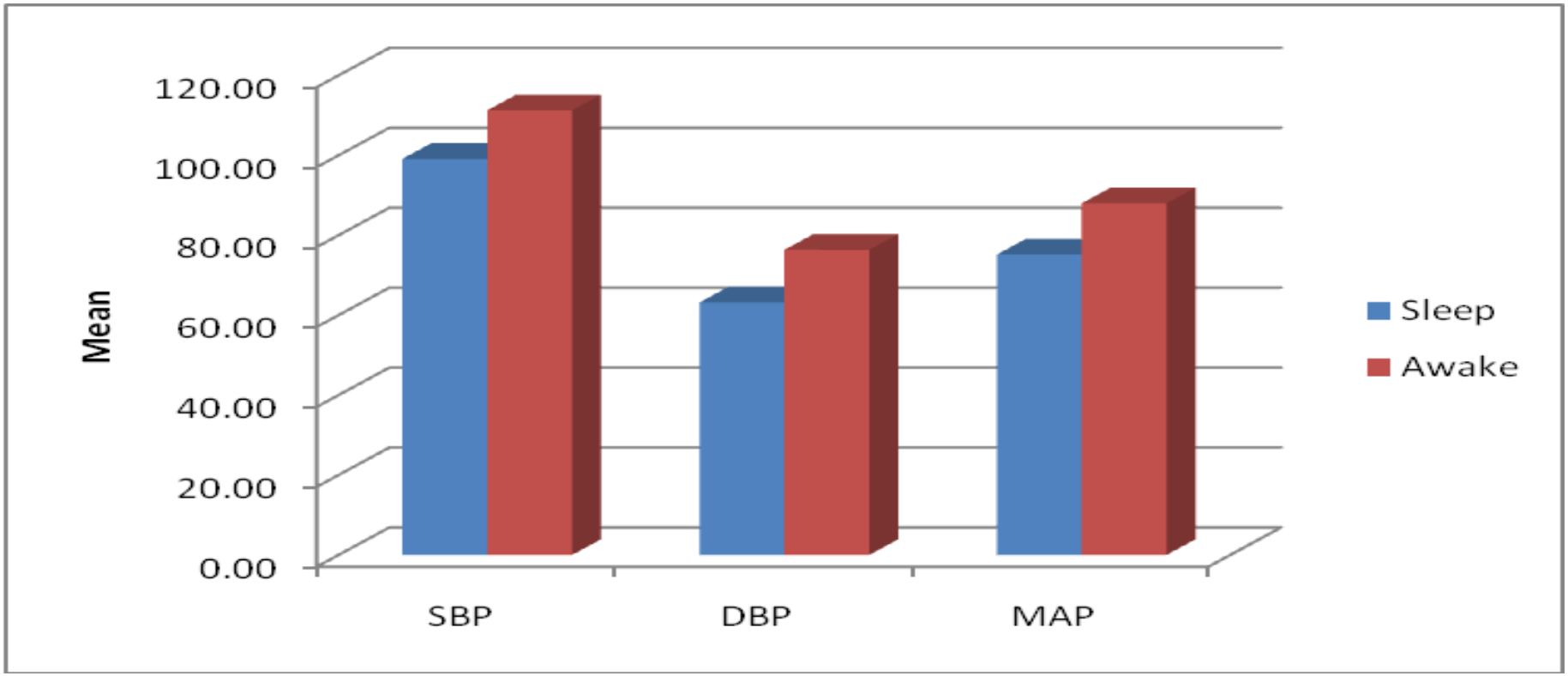

FIGURE 9: COMPARISON OF AWAKE AND SLEEP ABPM READING IN NIGHT DUTY

TABLE 8: COMPARISON OF AWAKE AND SLEEP ABPM READING IN DAY DUTY

Day Duty	Sleep(night time)		Awake(day time)		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
SBP	96.24	9.00	111.01	10.19	-11.850	0.000	-14.77	6.83	-17.32	-12.22
DBP	61.71	7.21	74.07	7.68	-8.978	0.000	-12.35	7.54	-15.17	-9.54
MAP	73.22	7.18	86.38	7.81	-10.988	0.000	-13.16	6.56	-15.61	-10.71

The mean SBP in day shift during sleeping hours was 96.24±9.00 which was lower than awake hours 111.01±10.19 with significant p-value (<0.05). The mean DBP in day shift during sleeping hours was 61.71±7.21 and which was lower than awake hours 74.07±7.68 with significant p-value (<0.05). The mean MAP in day shift during sleeping hours was 73.22±7.18 which was lower than awake hours 86.38±7.81 with significant p-value (<0.05).

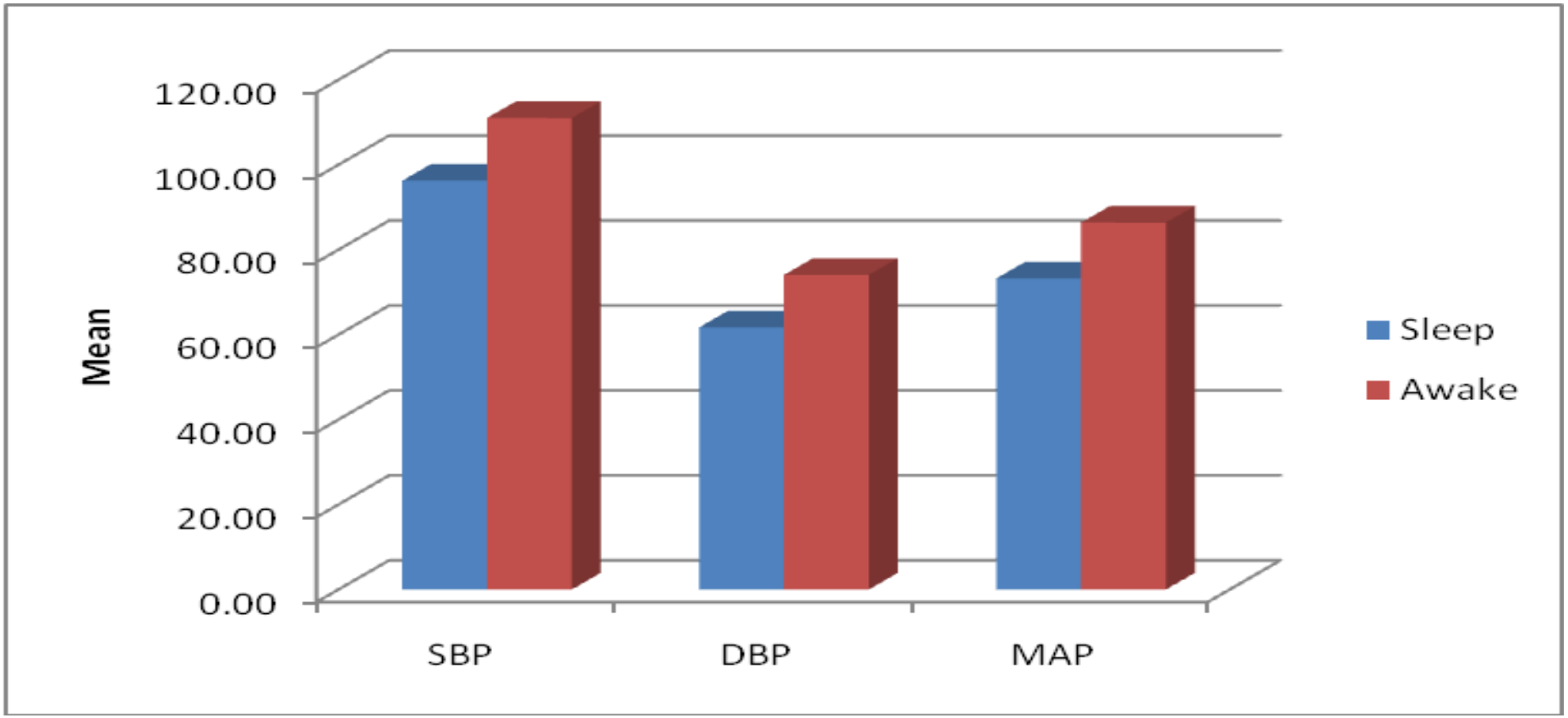

FIGURE 10: COMPARISON OF AWAKE AND SLEEP ABPM READING IN DAY DUTY

TABLE 9: COMPARISON OF 24 HOUR ABPM READINGS DAY AND NIGHT DUTY

24 HOUR ABPM READINGS	Day Duty		Night Duty		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
SBP	103.62	8.99	105.17	9.25	1.474	0.151	1.55	5.76	-0.60	3.70
DBP	67.89	6.43	69.76	7.21	1.524	0.138	1.87	6.72	-0.64	4.38
MAP	79.80	6.75	81.56	7.63	1.611	0.118	1.76	5.99	-0.47	4.00

24 hour mean SBP during night duty was 105.17±9.25 which was slightly higher than day shift 103.62±8.99 with insignificant p-value (>0.05). 24 hour mean DBP during night duty was 69.76±7.21 which was slightly higher than day shift 67.89±6.43 with insignificant p-value (>0.05). 24hr mean MAP during night duty was 81.56±7.63 which was higher than day shift 79.80±6.75with insignificant p-value (>0.05). 24 hour mean of SBP, DBP, and MAP was found to be insignificant in both the shifts may be due to small sample size.

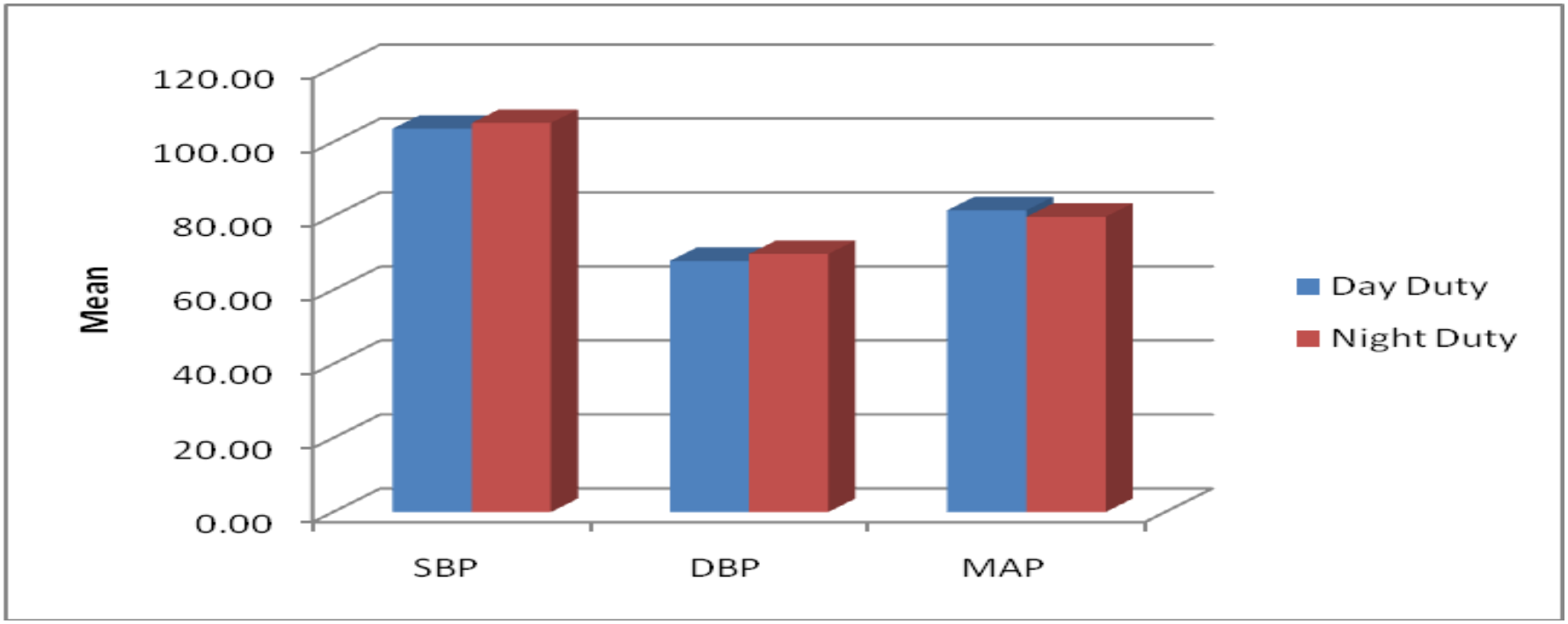

FIGURE 11: COMPARISON OF 24 HOUR ABPM READINGS DAY AND NIGHT DUTY

TABLE 10: COMPARISON OF EARLY MORNING SURGE IN DAY AND NIGHT DUTY

EARLY MORNING SURGE	Day duty		Night duty		T	p-value	Difference	
	Mean	SD	Mean	SD			Mean	SD
SBP	108.28	11.59	109.29	11.60	-0.51	0.611	-1.02	10.83
DBP	73.10	7.99	73.35	9.82	-0.13	0.896	-0.25	10.39
MAP	83.50	7.28	86.91	9.80	-1.56	0.129	-3.41	11.96

Ambulatory blood pressure readings were recorded during day and night shifts in early morning hours (6:00 A.M to 10:00 A.M). The mean SBP in day shift was 108.28±11.59 and in night shift was 109.29±11.60 (p-value >0.05). The mean DBP in day shift was 73.10±7.99 and in night shift was 73.35±9.82 (p-value >0.05). The mean MAP in day shift 83.50±7.28 and in night shift 86.91±9.80 (p-value >0.05). There is no significant difference in early morning blood pressure reading in both shifts may be due to insufficient sample size.

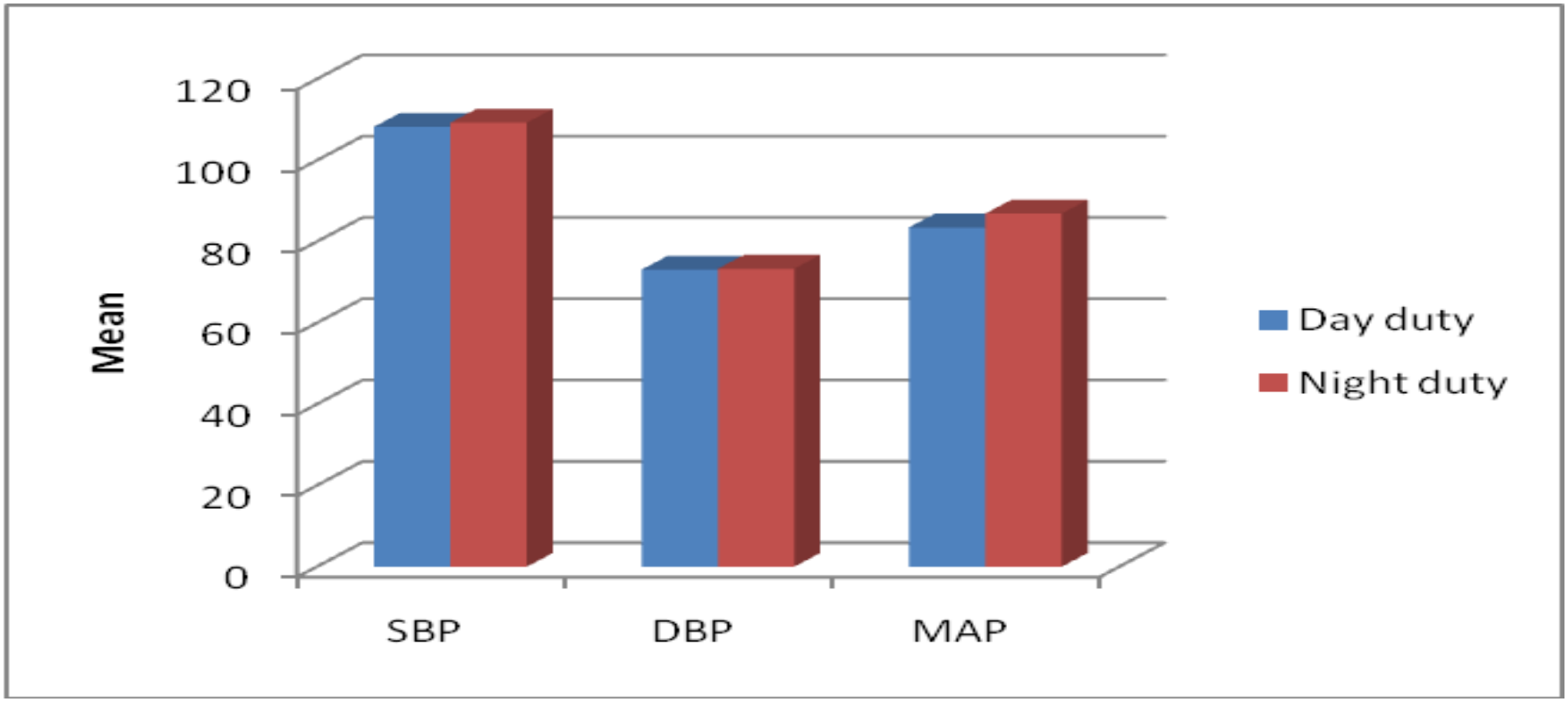

FIGURE 12: COMPARISON OF EARLY MORNING SURGE IN DAY AND NIGHT DUTY

TABLE 11: TYPE OF NOCTURNAL DIPPERS IN DAY DUTY

DAY DUTY	No. of cases	Percentage
DIPPERS	18	60%
NON DIPPERS	9	30%
REVERSE DIPPERS	0	0%
EXTREME DIPPERS	3	10%
TOTAL	30	100%

In day shift among 30 candidates 18 (60%) candidates were found to have normal nocturnal dipping, 09 (30%) candidates were non dippers, 3 (10%) were extreme dippers and there were no reverse dippers at all.

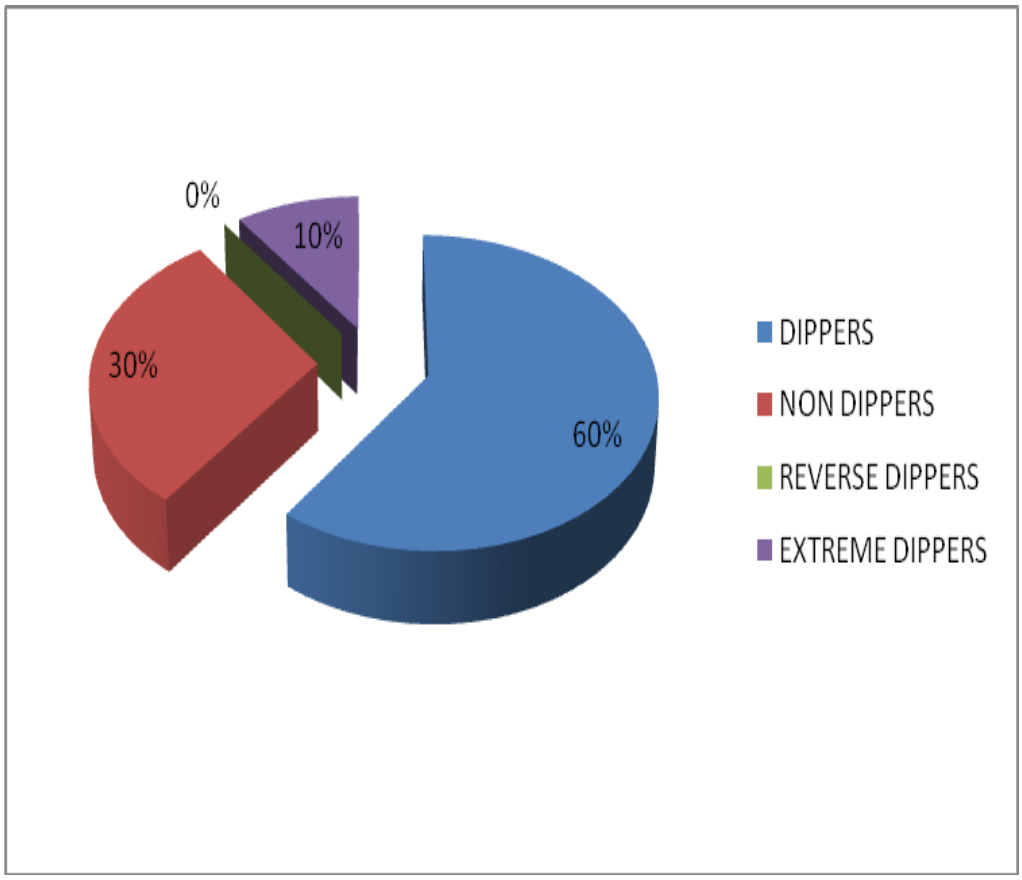

FIGURE 13: TYPE OF NOCTURNAL DIPPERS IN DAY DUTY

TABLE 12: TYPE OF NOCTURNAL DIPPERS IN NIGHT DUTY

NIGHT DUTY	No. of cases	Percentage
DIPPERS	15	50%
NON DIPPERS	10	33%
REVERSE DIPPERS	3	10%
EXTREME DIPPERS	2	7%
Total	30	100%

In night shift among 30 candidates 15(50%) candidates were found to have normal BP dipping, 10 (33.3%) candidates were non dippers, 03 (10%) candidates were reverse dippers and 2 (7%) were extreme dippers.

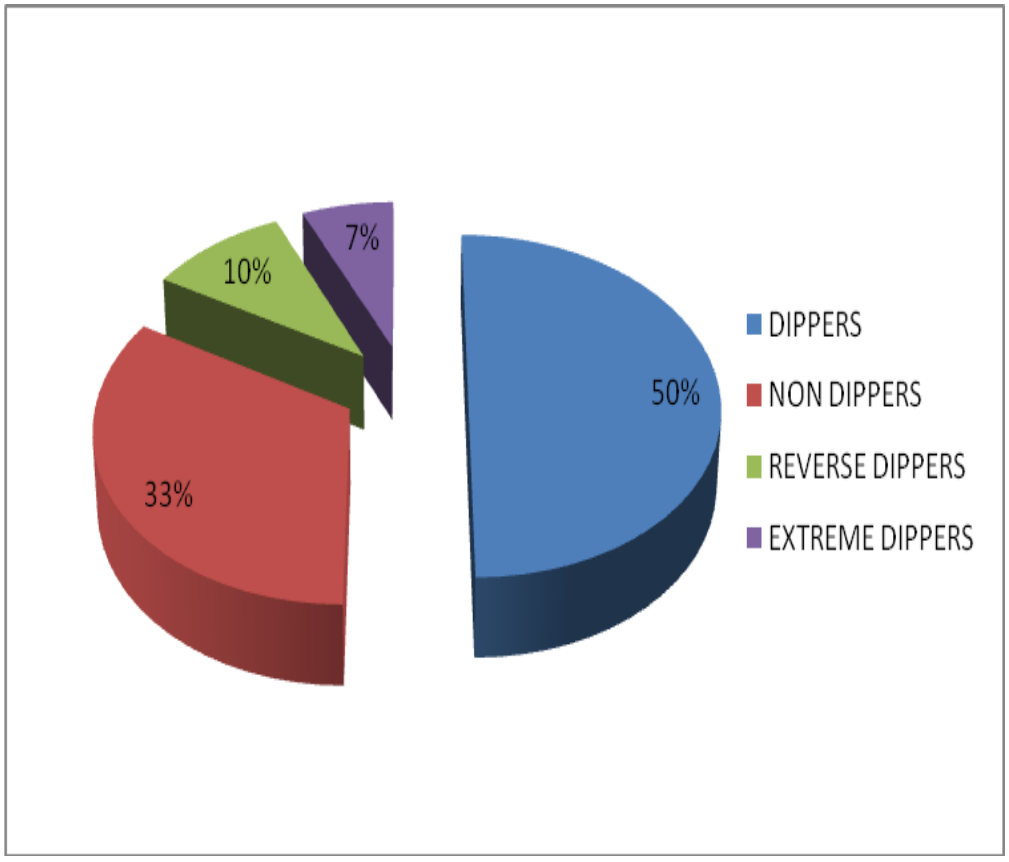

FIGURE 14: TYPE OF NOCTURNAL DIPPERS IN NIGHT DUTY

Normal dippers were found to be more in number in day duty as compared to night duty. Non dippers were more in night duty as compared to day duty. Extreme dippers were more in day duty as compared to night duty. But reverse dippers were only found in night duty candidates.

DISCUSSION

The present study was a prospective observational study conducted in 30 shift duty workers >30 years of age group during day and night shifts .This study included 20% males and 80% females comprising of staff nurses, sweepers, ward attendants, security guards and lab technicians. Out of the 30 candidates who participated in our study, the age group was in the range of 31 to 51 years old, with 50% candidates less than 40 years, 36% candidates between 40-50 years and 13% candidates were more than 50 years.

In our study, ambulatory blood pressure readings were recorded during day and night shifts while candidates were on duty and awake. We observed that the mean SBP in day shift during awake hours was 111.01±10.19 which was almost similar to mean SBP during night shift during awake hours of 111.24±10.28 with insignificant p-value (>0.05). The mean DBP in day shift during awake hours was 74.07±7.68 which was slightly higher than mean DBP during night shift awake hours of 76.34±8.29 with insignificant p-value (>0.05). The mean MAP in day shift was 86.38±7.81 which was almost similar to mean MAP in night shift of 87.98±8.67 with insignificant p-value (>0.05). Then ambulatory blood pressure readings were recorded during day and night shifts while candidates were off duty and sleeping. Mean SBP was found to be higher during sleep in day shift as compared to night shift of same candidates (p-value <0.05). Mean DBP and MAP were also slightly higher during sleep in day shift as compared to night shift but they were statistically insignificant, may be due to small sample size of our study.

Our study is similar to a study done by Fumiyasu Yamasaki et al[24], which showed that evaluating 58 day shift workers and 35 evening+ night shift workers, the evening+ night shift workers had a significantly smaller drop in systolic BP during sleep than day shift workers, largely attributable to higher sleep systolic BP in the evening+ night shift group. BP follows the cycle of rest and activity rather than the time of day, although the amplitude of the awake-sleep difference is somewhat

smaller for evening and night shift workers than for day shift workers. This can be one of the causes that working in evening or night shift alters the normal diurnal rhythm of BP.

A study conducted by Chaitra N D et al[64] found that the mean SBP and DBP were statistically high after a night shift duty when compared to their BP after day shift duty with P < 0.001. Possible mechanism for variation in BP could be shorter periods of sleep and disturbance of circadian rhythm. Similarly in another study by Lie T et al[65], systolic blood pressure was significantly influenced by shift working, while diastolic blood pressure was not (p-0.283). Working in a hospital on a 24 hour shift leads to abnormally high systolic blood pressure in female nurses. Similarly a study done by Kitamura T et al[58], shift workers demonstrated significantly higher systolic awake BP than regular day workers (136.5 mmHg vs. 132.5 mmHg, $p = 0.03$).

In our study mean SBP, DBP and MAP were found to be lower in both shifts during sleeping hours as compared to awake hours (p-value <0.05). In another study done on shift work of nursing professionals showed that the shift workers presented greater changes in blood pressure during sleep compared to those who did not work in shifts (45.9% vs. 31.8%, p = 0.036.[66]

According to some studies shift work is one of work hour systems in which a relay of employees extends the period of service beyond the conventional eight hour working day.[50,65] Acute sleep deprivation is associated with an increased sympathetic activity and decreased parasympathetic modulation.[3,4]

In our study during day shift, among 30 candidates, 18 (60%) candidates were found to have normal nocturnal dipping, 9 (30%) candidates were non- dippers, 3 (10%) candidates were extreme dippers and there were no reverse dippers at all. During night shift, among 30 candidates 15 (50%) candidates were found to have normal BP dipping, 10 (33.3%) candidates were non dippers, 2 (7%)

candidates were extreme dippers and 03 (10%) candidates were reverse dippers. Normal dippers were found to be more in number in day duty as compared to night duty. Non dippers were more in night duty as compared to day duty. Extreme dippers were more in day duty as compared to night duty. But reverse dippers were only found in night duty candidates.

This is in accordance to a study by Chau et al[49] suggesting that more evening+ night shift workers than day workers were classified as non-dippers may be due to the quality of sleep being impaired by shift work, as reflected by the higher sleep BPs in the shift workers. Probably the circadian rhythm, the rhythm of our activities and depending on their time of occurrence, all these factors may generate quite different blood pressure profiles. Some investigators also suggest that night-time blood pressure is more important than daytime blood pressure in predicting outcome, particularly in individuals whose nocturnal (sleep) blood pressure remains high (i.e. less than 10% lower than the daytime average — "non-dippers").[67]

In a study by Kitamura T et al [58], the circadian variation of BP changed from a dipper to a non-dipper pattern on the first day of the night shift and reversed to a dipper pattern within a few days. BP during sleep in the first day of the night shift was higher than on the other days. Some studies have reported higher sleeping BP in night shift work than in day shift work.[68]

A study by Fumiyasu Yamasaki et al[24] showed that the difference in dipper status between the groups was primarily due to a significantly higher sleep systolic BP in the evening+ night shift workers than in day shift workers (105.4 versus 99.4 mm Hg, $p<0.01$). The awake-sleep drop in diastolic BP was also smaller for the evening+ night shift workers than for the day shift workers (14.1 versus 17.0 mm Hg, $p<0.05$). Certain findings in our study might be limited because of the small sample size of our study and further studies are needed on a larger scale.

SUMMARY AND CONCLUSION

In our study we observed that-

1. The mean SBP was significantly higher while sleep hours in night duty as compared to day duty. DBP and MAP were also slightly higher but statistically insignificant.
2. There was statistically insignificant rise in mean SBP, DBP and MAP during awake period of night duty as compared to awake period of day duty.
3. The 24 hour mean SBP, DBP and MAP did not show any significant variation during day and night shift.
4. There were more normal nocturnal dippers in day shift as compared to night shift, i.e. 60% in day duty and 50% in night duty.
5. Non dippers were more in night shift as compared to day shift, i.e. 33.33% in night duty and 30% in day duty.
6. Extreme dippers were more in day duty as compared to night duty i.e. 10% in day duty and 7% in night duty.
7. Reverse dippers (10% of total candidates) were only present in night duty.

Hence, our study concludes that working in shifts alters the normal diurnal rhythm of BP.

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PROFORMA

S. NO.

NAME:

AGE:

SEX:

EDUCATION:

OCCUPATION:

ADDRESS:

CONTACT NO:

HEIGHT:

WEIGHT:

BMI:

HOURS OF DUTY:

TYPE OF DUTY:

EVENTS IN 24 HOURS:

- WALKING –
- MEALS -
- BREAKFAST:
- LUNCH:
- DINNER:
- SLEEP AT-
- WAKE UP AT-

Signature of Candidate **Signature of Supervisor**

Hour	Systolic BP	Diastolic BP	Mean BP	PP	Heart Rate

INVESTIGATIONS:

HB:

RBS:

CREATININE:

ECG:

Signature of Candidate **Signature of Supervisor**

S.NO	NAME	AGE	SEX	EDUCATION	OCCUPATION	HEIGHT	WEIGHT	BMI	HOURS OF DUTY		MEAN SBP			
									NIGHT	DAY	SLEEP		AWAKE	
											DAY DUTY	NIGHT DUTY	NIGHT DUTY	DAY DUTY
1	JS	51 YRS	MALE	12 th PASS	WARD ATTANDANT	179 CM	74 KG	23.1 KG/M2	12 HRS	8 HRS	120.5	127.66	122.67	142.00
2	SG	41 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	158 CM	60 KG	26.3 KG/M2	12 HRS	8 HRS	88.4	102.4	96.67	113.67
3	MK	43 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	173 CM	74 KG	24.7 KG/M2	12 HRS	8 HRS	90.76	84.6	101.33	97.33
4	J	33 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	155 CM	52 KG	21.6 KG/M2	12 HRS	6 HRS	99	96.5	114.00	107.67
5	S	35 YRS	FEMALE	5th PASS	SWEEPER	160 CM	50 KG	19 KG/M2	12 HRS	6 HRS	95.63	99	119.33	119.00
6	A	37 YRS	FEMALE	8th PASS	SWEEPER	152 CM	68 KG	27 KG/M2	10 HRS	6 HRS	100.5	105.83	112.33	109.33
7	PK	54 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	173 CM	54 KG	19 KG/M2	12 HRS	6 HRS	87.14	91	112.33	112.33
8	GK	33 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	173 CM	62 KG	21 KG/M2	12 HRS	8 HRS	96.16	92.8	116.33	115.00
9	SK	54 YRS	FEMALE	5th PASS	SWEEPER	161 CM	60 KG	23 KG/M2	12 HRS	6 HRS	96	94.2	115.00	106.67
10	A	31 YRS	FEMALE	10th PASS	SWEEPER	158 CM	59 KG	23 KG/M2	12 HRS	8 HRS	100.6	98.16	109.67	114.00
11	PK	42 YRS	MALE	B.Sc NURSING	STAFF NURSE	173 CM	65 KG	22 KG/M2	12 HRS	6 HRS	89	101.7	112.67	103.33
12	RK	32 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	167 CM	60 KG	22 KG/M2	12 HRS	6 HRS	91	87.14	111.33	116.00
13	KK	37 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	164 CM	65 KG	24 KG/M2	12 HRS	8 HRS	90.28	89.4	101.33	97.33
14	KK	36 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	156 CM	74 KG	30 KG/M2	10 HRS	8 HRS	89.37	93.8	100.33	101.67
15	BK	40 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	164 CM	64 KG	24 KG/M2	12 HRS	6 HRS	104.8	99.47	107.00	110.33
16	MS	47 YRS	MALE	12th PASS	WARD ATTANDANT	168 CM	72 KG	25.5 KG/M2	12 HRS	6 HRS	97.9	98.71	103.00	101.00
17	MK	35 YRS	FEMALE	8TH PASS	SWEEPER	160 CM	65 KG	25.3 KG/M2	8 HRS	8 HRS	116.2	111.37	108.67	121.67
18	RK	44 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	157 CM	60 KG	24.3 KG/M2	12 HRS	6 HRS	93.11	91.75	103.67	107.67
19	KK	42 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	168 CM	70 KG	24.8 KG/M2	10 HRS	6 HRS	91.14	88	105.67	111.00
20	NK	31 YRS	FEMALE	10th PASS	WARD ATTANDANT	163 CM	68 KG	25.5 KG/M2	12 HRS	8 HRS	97	92.71	109.00	107.67
21	HK	32 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	163 CM	58 KG	21.8 KG/M2	12 HRS	6 HRS	96.3	98	109.00	100.00
22	KS	47 YRS	MALE	B.Sc NURSING	STAFF NURSE	173 CM	68 KG	22.7 KG/M2	12 HRS	8 HRS	97.45	98.42	108.00	113.00
23	K	42 YRS	FEMALE	12th PASS	WARD ATTANDANT	155 CM	70 KG	29.13 KG/M2	12 HRS	6 HRS	88.1	97	107.00	110.00
24	RK	35 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	160 CM	64 KG	25 KG/M2	8 HRS	8 HRS	91.5	107	114.67	107.00
25	MK	50 YRS	FEMALE	B.Sc MEDICAL LAB SCIENCES	LAB TECHNICIAN	168 CM	60 KG	21.1 KG/M2	8 HRS	8 HRS	91.62	107.42	112.67	107.33
26	PS	36 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	165 CM	59 KG	21.6 KG/M2	12 HRS	8 HRS	88	93.7	106.67	110.00
27	R	38 YRS	FEMALE	B.Sc NURSING	STAFF NURSE	155 CM	72 KG	29.9 KG/M2	12 HRS	6 HRS	92.25	97.3	114.67	114.67
28	AS	52 YRS	MALE	12th PASS	SECURITY GUARD	175 CM	87 KG	28.5 KG/M2	12 HRS	6 HRS	121.5	126.85	155.67	140.67
29	SK	44 YRS	FEMALE	10th PASS	SECURITY GUARD	164 CM	74 KG	27.5 KG/M2	12 HRS	6 HRS	90.3	107	117.67	101.67
30	PS	46 YRS	MALE	12 th PASS	SECURITY GUARD	167 CM	69 KG	24.7 KG/M2	12 HRS	6 HRS	95.6	94.2	109.00	111.33

S.NO	NAME	MEAN DBP				MEAN MAP				MEAN SBP IN EARLY MORNING		MEAN DBP IN EARLY MORNING		MEAN MAP IN EARLY MORNING		HB (g/dl)	RBS (mg/dl)	CREATININE (mg/dl)	ECG
		SLEEP		AWAKE		SLEEP		AWAKE		DAY DUTY	NIGHT DUTY	DAY DUTY	NIGHT DUTY	DAY DUTY	NIGHT DUTY				
		DAY DUTY	NIGHT DUTY	DAY DUTY	NIGHT DUTY	DAY DUTY	NIGHT DUTY	DAY DUTY	NIGHT DUTY										
1	JS	78.00	76.50	77.33	87.67	92.17	93.55	92.44	105.78	126.60	134.20	89.00	72.30	87.88	106.33	14.10	96.00	0.90	NORMAL SINUS RHYTHM
2	SG	61.25	67.33	69.67	82.00	70.30	79.02	78.67	92.56	87.28	106.50	87.28	75.57	66.80	84.75	12.40	86.00	0.60	NORMAL SINUS RHYTHM
3	MK	68.45	64.81	63.33	64.33	75.89	71.41	76.00	75.33	106.27	96.88	72.50	61.80	84.57	78.66	11.20	87.00	0.70	NORMAL SINUS RHYTHM
4	J	59.22	57.20	82.33	78.33	72.48	70.30	92.89	88.11	111.09	100.88	68.00	59.99	83.71	88.00	10.40	89.00	0.70	NORMAL SINUS RHYTHM
5	S	60.63	62.50	80.67	76.33	72.30	74.67	93.56	90.56	125.55	119.00	71.00	56.16	80.10	71.25	11.20	79.00	0.89	NORMAL SINUS RHYTHM
6	A	61.50	58.71	72.33	81.00	74.50	74.42	85.67	90.44	106.42	103.14	75.42	71.50	91.80	81.33	12.20	128.00	0.56	NORMAL SINUS RHYTHM
7	PK	56.42	55.20	77.33	75.33	66.66	67.13	89.00	87.67	103.66	100.88	60.83	69.22	83.25	88.00	10.60	79.00	1.10	NORMAL SINUS RHYTHM
8	GK	56.40	60.75	71.33	76.33	69.65	71.43	86.33	89.22	108.37	99.00	71.71	78.16	86.00	91.71	11.20	110.00	0.62	NORMAL SINUS RHYTHM
9	SK	60.80	58.20	78.67	68.00	72.53	70.20	90.78	80.89	108.90	100.88	74.70	69.22	86.33	92.20	10.20	67.00	0.80	NORMAL SINUS RHYTHM
10	A	59.11	54.83	72.67	62.00	72.94	69.27	85.00	79.33	112.18	116.66	77.40	69.71	82.42	87.20	10.60	126.00	0.69	NORMAL SINUS RHYTHM
11	PK	61.14	65.87	79.00	74.33	70.43	77.81	90.22	84.00	87.28	105.00	59.42	67.50	69.25	84.75	14.40	96.00	0.90	NORMAL SINUS RHYTHM
12	RK	55.20	51.50	79.67	78.67	67.13	63.38	90.22	91.11	100.88	103.60	66.25	62.33	92.20	84.75	12.10	78.00	0.43	NORMAL SINUS RHYTHM
13	KK	56.84	54.77	63.33	64.33	67.99	66.31	76.00	75.33	106.27	95.20	72.50	62.77	88.00	82.00	10.80	110.00	0.86	NORMAL SINUS RHYTHM
14	KK	61.12	59.60	69.33	71.33	70.54	71.00	79.67	81.44	87.28	102.30	79.42	71.71	74.25	86.00	11.80	113.00	0.56	NORMAL SINUS RHYTHM
15	BK	59.00	55.85	71.33	70.33	74.27	70.39	83.22	83.67	120.55	102.18	75.22	71.40	98.60	81.14	9.60	96.00	0.43	NORMAL SINUS RHYTHM
16	MS	66.20	62.37	67.67	70.33	76.77	74.48	79.44	80.56	104.20	113.20	73.20	79.40	83.80	92.00	14.20	112.00	0.80	NORMAL SINUS RHYTHM
17	MK	80.20	76.00	74.67	81.00	92.20	87.79	86.00	94.56	126.20	117.00	83.20	81.20	93.60	91.80	11.20	106.00	0.68	NORMAL SINUS RHYTHM
18	RK	59.44	62.00	81.67	82.00	70.66	71.92	89.00	90.56	111.66	106.33	74.33	76.00	83.33	85.00	10.60	74.00	0.64	NORMAL SINUS RHYTHM
19	KK	55.71	59.00	78.67	74.00	67.52	68.67	87.67	86.33	111.00	105.00	71.00	73.33	85.66	81.00	9.60	86.00	0.52	NORMAL SINUS RHYTHM
20	NK	59.42	57.00	76.33	77.33	71.95	68.90	87.22	87.44	107.66	109.00	77.00	76.33	91.66	90.00	12.20	94.00	0.74	NORMAL SINUS RHYTHM
21	HK	54.80	60.00	75.67	57.00	68.63	72.67	86.78	71.33	97.00	111.00	56.66	73.00	71.00	86.30	10.20	78.00	0.61	NORMAL SINUS RHYTHM
22	KS	63.47	62.55	77.33	75.00	74.80	74.51	87.56	87.67	115.00	105.00	78.00	79.00	87.69	71.00	13.90	94.00	0.74	NORMAL SINUS RHYTHM
23	K	53.70	67.00	77.33	67.67	65.17	77.00	87.22	81.78	98.60	108.60	65.00	82.70	78.00	74.60	10.90	109.00	0.42	NORMAL SINUS RHYTHM
24	RK	63.00	68.42	82.00	73.33	72.50	81.28	92.89	84.56	101.60	114.50	66.00	76.75	76.00	86.75	10.40	112.00	0.71	NORMAL SINUS RHYTHM
25	MK	52.37	68.00	74.00	74.00	65.45	81.14	86.89	85.11	105.33	117.00	70.00	82.00	82.33	92.66	12.60	92.00	0.56	NORMAL SINUS RHYTHM
26	PS	74.75	72.30	72.33	80.33	79.17	79.43	83.78	90.22	100.25	113.20	67.00	79.40	75.75	92.00	11.40	98.00	0.86	NORMAL SINUS RHYTHM
27	R	60.62	57.80	78.00	81.33	71.16	70.97	90.22	92.44	110.70	95.00	76.50	57.00	84.25	73.00	11.00	84.00	0.72	NORMAL SINUS RHYTHM
28	AS	76.62	91.00	111.00	84.67	91.58	102.95	125.89	103.33	138.50	151.40	90.25	107.20	82.75	120.60	14.60	129.00	0.69	NORMAL SINUS RHYTHM
29	SK	55.00	68.75	81.33	57.00	66.77	81.50	93.44	71.89	110.00	117.25	69.06	80.50	88.90	93.30	10.10	82.00	0.75	NORMAL SINUS RHYTHM
30	PS	61.02	59.40	74.00	76.67	72.55	71.00	85.67	88.22	112.00	109.00	75.20	77.40	85.10	89.30	14.60	130.00	0.82	NORMAL SINUS RHYTHM

S.NO	NAME	NOCTURNAL BP DIPPING	
		DAY DUTY	NIGHT DUTY
1	JS	15.14085	-4.07065
2	SG	22.22874	-5.93103
3	MK	6.753425	16.51316
4	J	8.049536	15.35088
5	S	19.63866	17.03911
6	A	8.079268	5.789318
7	PK	22.4273	18.9911
8	GK	16.38261	20.22923
9	SK	10	18.08696
10	A	11.75439	10.4924
11	PK	13.87097	9.733728
12	RK	21.55172	21.73054
13	KK	7.246575	11.77632
14	KK	12.09508	6.511628
15	BK	5.015106	7.037383
16	MS	3.069307	4.165049
17	MK	4.493151	-2.48773
18	RK	13.52012	11.49518
19	KK	17.89189	16.71924
20	NK	9.907121	14.94495
21	HK	3.7	10.09174
22	KS	13.76106	8.87037
23	K	19.90909	9.345794
24	RK	14.48598	6.686047
25	MK	14.63975	4.656805
26	PS	20	12.15625
27	R	19.54942	15.14535
28	AS	13.62559	18.51178
29	SK	11.18033	9.065156
30	PS	14.13174	13.57798

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No. BFUHS/2K19p-TH/ 10399 Date 9/9/19

The Principal,
DMC, Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.05.2019 has approved the plan of thesis of **Navjot Kaur**, a student of your college for **MD General Medicine** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis

A study of effect of shift duty on diurnal variations in blood pressure with ambulatory blood pressure monitoring

Supervisor
Dr. Narender Pal Jain
Prof.,
Dept. of Medicine,
DMCH, Ludhiana.

Co-Supervisor
Dr. Gurpreet S. Wander
Prof. & Head,
Dept. of Cardiology,
DMCH, Ludhiana.

Dr. Shibba Takkar
Assoc. Prof.,
Dept. of Cardiology,
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The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

SP Singh

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF MEDICINE

IN

MEDICINE

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES
FARIDKOT

NOVEMBER, 2018 **Dr. Navjot Kaur**

DEPARTMENT OF MEDICINE
DAYANAND MEDICAL COLLEGE & HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING
For the degree of	M.D. (Medicine)
Name of the candidate	Dr. Navjot Kaur
Supervisor	Dr. Narender Pal Jain, Professor, Department of Medicine, DMCH, Ludhiana
Co-supervisor(s)	Dr. Gurpreet S Wander, Professor & Head, Department of Cardiology, DMCH, Ludhiana Dr. Shibba Takkar, Associate Professor, Department of Cardiology, DMCH Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Ambulatory blood pressure monitoring measures blood pressure at regular intervals in 24 hrs of time period. It is done with the help of portable blood pressure measuring device which is worn for about 24 hrs. Blood pressure measured in clinical set up do not reflect blood pressure variability and nocturnal blood pressure levels. Unique data provided by ambulatory blood pressure monitoring includes 24 hr average blood pressure, daytime (awake) blood pressure, night time (asleep) blood pressure, systolic blood pressure load, diastolic blood pressure load, nocturnal dipping of blood pressure.

Aim of Study: A study of effect of shift duty on diurnal variations in blood pressure with ambulatory blood pressure monitoring.

Materials & Methods: This study will be a prospective study and will be conducted on shift duty workers. A Total of 30 candidates will be taken in this study after the informed consent. There will be two sessions of ambulatory blood pressure monitoring. First will be conducted after 4th day of the day shift duty and second will be conducted after 4th day of the night shift duty in same individual. The time period between these two sessions will not be more than 2 months. Blood pressure monitoring will be done after every 20 minutes in day time and 60 minutes at night time.

Inclusion Criteria: Age >30 years, Participants interested in study, Working at nights/ on rotational duty/ alternating shifts.

Exclusion Criteria: Age <30 years. Those who are not interested in participation.

Clinical Significance: Ambulatory blood pressure monitoring can detect abnormal fluctuations in blood pressure that might go unnoticed when blood pressure is only measured in the clinic. Ambulatory blood pressure can identify patients with abnormal patterns of nocturnal blood pressure. Sleep restriction and deprivation has been linked to an increased incidence hypertension in both the normotensive population and already hypertensive population.

Keywords: Ambulatory blood pressure monitoring, shift duty, circadian rhythm.

(Signature) Candidate	(Signature) Co-supervisor	(Signature) Co-supervisor	(Signature) Supervisor	(Signature) Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis entitled "**A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING**" exist in the Department of Medicine, Dayanand Medical College & Hospital, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis are genuine and is collected by the candidate herself under our supervision and guidance.

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5	TITLE OF THE TOPIC	A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Diurnal fluctuation in blood pressure is a well known phenomenon. Average nocturnal blood pressure is approximately 15 mm of Hg lower than day time. This phenomenon can't be seen in office blood pressure and home blood pressure monitoring. Ambulatory blood pressure monitoring is far superior to office based blood pressure monitoring in predicting 24 hour average blood pressure, day blood pressure (awake), night time (asleep) blood pressure, systolic blood pressure load, diastolic blood pressure load, nocturnal dipping of blood pressure. Ambulatory blood pressure is also a better representative of actual blood pressure as office blood pressure is affected by multiple factors including observer error and patient related factors. Ambulatory blood pressure is also useful in studying abnormality of the diurnal rhythm, the short term variability, masked hypertension, white coat hypertension and pseudo resistant hypertension.

The most important physiological mechanism regarding the night shift work is the problem of entrainment (resynchronization) of physiological functions after a phase shift of working and sleeping time and has been reported that the resynchronization of circadian rhythm in blood pressure to a night shift schedule occurs much more rapidly than other circadian parameters such as body temperature. This implies that blood pressure circadian rhythm in sleep-wakefulness. The Circadian blood pressure pattern is changed from a dipper to a non dipper pattern on the first day of the night shift and reverses to a dipper pattern within a few days.

Majority of circadian rhythm in our body have both an endogenous

component regulated by suprachiasmatic nuclei and an exogeneous component composed of light dark cycle. 24 hour blood pressure monitoring detects dippers, non dippers, reverse dippers and extreme dippers. It can also measure systolic, diastolic blood pressure load and assess blood pressure variability over the 24 hrs period. It is therefore important to study the effect of shift duty on circadian rhythm which is done with ambulatory blood pressure monitoring.

6.2 REVIEW OF LITERATURE

24 HOUR BLOOD PRESSURE PROFILE

24 hour blood pressure profiling with the use of ambulatory blood pressure monitoring was first introduced 40 yrs ago.[1] 24 hour ambulatory blood pressure monitoring offers the ability to monitor subjects throughout their daily routines and is useful in identifying patterns of dynamic blood pressure changes during different activities.[1,2] It is useful for predicting the development of hypertension and Cardiovascular disease. This method has been used often to assess 24 hour blood pressure profiles in the shift work population, most notably night shift workers.[2,3] Increased systolic and diastolic pressures, as well as heart rate, have been reportedly linked to nightshift workers. Variation of blood pressure throughout the day can be monitored only by Ambulatory blood pressure monitoring.[4] Night shift workers are reported to have a greater blood pressure during a work day when compared to a non working day.[5]

Blood pressure increases as small as 5 mmHg for systolic and diastolic blood pressure can be clinically relevant, especially if re-occuring over extended periods of time by increasing the risk of adverse cardiovascular events.

24 HOUR AMBULATORY BLOOD PRESSURE MONITORING

Physicians are more frequently prescribing a blood pressure monitoring device, and the two options are self blood monitoring or 24 hour ambulatory blood pressure monitoring. The 24 hour ambulatory blood pressure monitoring option is preferred due to its reliability and ability to record nocturnal blood pressure monitoring unlike self blood pressure monitoring.[6] The physician

can set the monitor to take readings multiple times per hour.

24 hour ambulatory blood pressure monitoring is classified differently because blood pressure measurements are taken over a longer duration of time, including both ambulatory and sleep periods. Normal day time ambulatory blood pressure monitoring measurements are typically <130/85 mmHg, while night time measurements drop down to approximately 110/70 mmHg. This night time drop is believed to be due to a decrease in heart rate, a decrease in physical activity , and the postural change that takes place while lying down.

HYPERTENSION

Hypertension is one of the most common types of cardiovascular disease.[7] hypertension is defined as blood pressure levels that are high enough to cause damage to the heart, blood vessels, and other organs. There are two forms of hypertension, primary hypertension and secondary hypertension. Primary hypertension is more common; about 95% of all diagnosed cases. It is thought that primary hypertension is the combination of multiple blood pressure regulation problems and environmental stressors, which makes it more difficult to treat. Secondary hypertension develops after another medical problem has arisen in the body, thus an effective treatment is more likely. Physiologically, blood pressure falls by >10% during nighttime (asleep). When blood pressure fall by <10% during nighttime, it is defined as nondipping. It is associated with increased risk of stroke, end organ damage, and cardiovascular events including death.[8] Several studies showed an association between morning blood pressure surge was associated with decreased mortality in nondipping hypertension patients.[9]

SHIFT WORK

Shift work is identified as work hours that extend beyond the normal 8-hour work day of 8A.M. to 5 P.M. It is common for these shifts to be 12 hours or longer, and they are often worked in succession to one another.[10-12] There are shift work and fixed day and night shift work.[13] Nearly all body functions are rhythmic and cyclic; working extended periods of night shift work or rotating shift work can alter the body's normal patterns.[14-16] These alterations can impact weight, physical activity, social interaction and sleep. The human sleep-wake cycle functions under the command of two systems: 1) the circadian system which promotes wakefulness and 2) the homeostatic system which promotes sleep.[15,17] When these internal regulatory mechanisms get out of synchronization, the body cannot maintain its normal sleep/wake cycles. Due to the nature of shift work, the altering of these bodily functions, individuals participating in shift work are at risk for health problems such as sleep disorders, cardiovascular disease, digestive problems and psychological disorders. The demands of shift work include elevated mental stress and altered regulatory functions, all of which have the potential to increase blood pressure and ultimately increasing the risk of cardiovascular disease. It has also been reported that long term exposure to increased blood pressure, secondary to sleep deprivation, can cause the cardiovascular system to reset its normal blood pressure levels to that of a higher blood pressure, causing body to operate on an elevated blood pressure level on a regular basis.[18] A study shows that day shift workers show typical circadian rhythms with a drop in both systolic and diastolic blood pressure at night. This pattern was reversed in night-shift workers.[19] A change in the working time

profoundly perturbed the 24 hour blood pressure profile.[20]

SLEEP DURATION IN SHIFT WORKERS

Depriving healthy subjects of sleep has been shown to acutely increase blood pressure and sympathetic nervous system activity. Prolonged short sleep durations could lead to hypertension through extended exposure to raised 24 hour blood pressure and heart rate, elevated sympathetic nervous system activity, and increased salt retention.[20] Sleep restriction and deprivation has been linked to an increased incidence hypertension in both the normotensive population and already hypertensive population.[20] Usual sleep duration above and below the median of 7 to less than 8 hours per night is associated with an increased prevalence of hypertension, particularly at the extreme of less than 6 hours per night.[21] The rhythm of the human body is characterized with an alternating sleep wake cycle. Among healthy subjects, sleep tend to occur during a particular phase of circadian cycle. Those who work in night shift may attempt to sleep when there body clock is adjusted for the awakening phase. This attempt disturbs the body clock resulting in a contradictory relationship between sleep time and circadian regulation which has adverse effect on family and social life. The average sleep cycle for night shift workers is sleep during the day. Which may be 2-4 hours shorter than that of the day worker sleeping at night. Day sleep is light, fragmented and more likely to be distrupted and hence the insomnia can be severe in night shift workers. It is possible that circadian sleep propensity rhythm and hormonal rhythm are under influence of circadian pacemaker as well as sleep habit.

6.3 AIMS AND OBJECTIVES OF THE STUDY

A study of effect of shift duty on diurnal variations in blood pressure with ambulatory blood pressure monitoring.

7. MATERIALS AND METHODS

This study will be a prospective study and will be conducted on shift duty workers. A Total of 30 candidates will be taken in this study after the informed consent. There will be two sessions of ambulatory blood pressure monitoring. First will be conducted after 4th day of the day shift duty and second will be conducted after 4th day of the night shift duty in same individual. The time period between these two sessions will not be more than 2 months. Blood pressure monitoring will be done after every 20 minutes in day time and 60 minutes at night time.

7.1 Source of Data

Shift duty workers working at nights/ on rotational duty/ alternating shifts.

7.2 METHOD OF COLLECTION OF DATA

Patient's history, clinical examination and all investigations will be noted down as per detailed performa.

INCLUSION CRITERIA

- Age >30 years.
- Participants interested in study.
- Working at nights/ on rotational duty/ alternating shifts

EXCLUSION CRITERIA

- Age <30 years.
- Those who are not interested in participation

OUTCOME- To observe whether there is any effect of shift duty on diurnal blood pressure or not.

STATISTICAL ANALYSIS- Data will be described in terms of range; mean

±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the groups will be done using Paired t-test for parametric data. A probability value (*p* value) less than 0.05 will be considered statistically significant. All statistical calculations will be done using SPSS (Statistical Package for the Social Science) SPSS 17 version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached along with

LIST OF REFERENCES

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PROFORMA

S. NO.

NAME:

AGE:

SEX:

EDUCATION:

OCCUPATION:

ADDRESS:

CONTACT NO:

HEIGHT:

WEIGHT:

BMI:

HOURS OF DUTY:

TYPE OF DUTY:

EVENTS IN 24 HOURS:

- WALKING –
- MEALS -
- BREAKFAST:
- LUNCH:
- DINNER:
- SLEEP AT-
- WAKE UP AT-

Signature of Candidate **Signature of Supervisor**

Hour	Systolic BP	Diastolic BP	Mean BP	PP	Heart Rate

INVESTIGATIONS:

HB:

RBS:

CREATININE:

ECG:

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I……..D/o, W/o, S/o…….

am willing to participate in the study **"A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

……. ……

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी /पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य "**A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्दोश्य स्पष्टर कर दिया गया है और मुझे यह विश्वायस है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्तम कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्ती करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर /अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____ _____

“A STUDY OF EFFECT OF SHIFT DUTY ON DIURNAL VARIATIONS IN BLOOD PRESSURE WITH AMBULATORY BLOOD PRESSURE MONITORING” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

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ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

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ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ